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ABSTRACT

Aptitude-treatment interaction was used to determine if learners with a preference for a holistic learning style (as opposed to a serialist learning style) learn more effectively with non-linear, rather than linear, instructional materials. One hundred and fifty college students underwent pretesting for content familiarity with the basics of photography. Then three tests, all drawn from the 1976 edition of the ETS "Kit of Factor Referenced Cognitive Tests," were administered to determine the students' learning styles. Next the participants were randomly assigned to two audiovisual presentations, one linear (a conventional tape-slide presentation) and the other non-linear (a multi-image tape-slide presentation). Learning was measured with both immediate posttests and delayed retention tests. The results of the study showed that the matching of the holistic learners and the non-linear instructional materials yielded no better outcomes with regard to increased learning effectiveness than the matching of holistic learners with linear instructional materials. (LLS)

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VISUAL INSTRUCTIONAL STRATEGIES AND COGNITIVE STYLE

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INTRODUCTION

This research* endeavored to develop and evaluate instructional materials that would match the needs of learners identified as "holistic" in their learning preference. Thus, the study followed the aptitude-treatment interaction format to assess possible match/mismatch situations between learner variables and instructional variables. The research hypothesis was that matching learner preferences (herein termed as either "holistic" or "serialistic") with instructional treatment configurations (herein termed "non-linear" and "linear," respectively) would yield better performance than would the corresponding mismatch conditions, and would do so at a statistically significant level.

RATIONALE

This study was prompted by several concerns: first, to improve learning, cognitive style literature has been exhorting the instructional design community to identify and develop materials to match the various learning styles; second, hemisphericity research which derives from studies of the "split brain" and has repeatedly drawn elusive parallels to cognitive style, as well as research on "appositionality" (Bogen, 1969) have both indicated that many complex aspects of visual learning may reside in that right-hemispheric "appositionality;" third, learning from so-called non-linear visual presentations (Allen & Cooney, 1963) is being more-and-more thought of as a powerful tool for informing viewers and has consequently led to the blossoming of the multi-image presentation industry, even though little in the way of concrete demonstration of its instructional strengths has been shown since Brydon's 1972 study; and fourth, studying these questions seemed amenable to an experimental design that would follow the aptitude-treatment interaction model with which the researcher wanted to experiment, using the stepwise multiple regression analysis technique (recommended for such research by Cronbach & Snow, 1977) and which is readily analyzable using the SPSS computerized statistical analysis package.

Various informal sources also suggested that this same non-linear presentation technique might turn out to provide a match for holistic learners (e.g., salesmen, who are viewed as essentially holistic problem solvers seem exceptionally open to multi-image presentations and the simultaneity ascribed to holistic processing is

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* The work reported herein represents a part of a study conducted for the doctoral dissertation submitted to the Graduate School of Education, University of California, Los Angeles.

certainly an integral component in the conceptualization of multi-imagery). Consequently this type of match was considered as a proper research vehicle.

VARIABLES

The cognitive style question has been undergoing extensive investigation--especially as regards the field-dependence/independence duality (already under discussion at this meeting) and which the ETS-based group under the leadership of the late Herman Witkin (Witkin, Oltman, Cox, Ehrlichman, Hamm, & Ringler, 1973, and supplements in 1974 and 1976) has documented with over 2000 reports. This study also took into consideration the field-dependence/independence variables (although not by using the conventional measures, namely the rod-and-frame test or the Embedded-Figures Test) while also attempting to include the hemisphericity-based appositionality /propositionality (A/P) duality into the variable.

Bogen defined propositionality to include most of our conventional verbally-oriented, sequential types of learning, whereas the less obvious (because of its residing in the "silent hemisphere") appositionality includes various non-sequential or simultaneous, visual, gestalt-organization-oriented types of learning.

The measures of appositionality that have been used are the gestalt-closure tests (typically, the one designed by Street--and published in 1931--although others exist as well) wherein those that perform well on them are considered appositional. Those who do well on verbal or sequential-reasoning tasks are labelled as propositionals. Because the two capabilities are not mutually exclusive (because here two *different* tests are used, as compared to the field-dependence/independence variable which is based on one single test) individuals can--as regards appositionality/propositionality--enjoy either, both, or neither to varying degrees. This, in turn has led to the investigation of what appears as a more interesting appositionality/propositionality (or A/P) *ratio* which has resulted in some interesting studies (Bogen, DeZure, TenHouten, and Marsh, 1972 and Harshman, Crawford, and Hecht, 1976).

In this study the attempt was made to go even one step further and to look for an even more complex composite labelled "holistic" or non-linear learning preference versus a "serial" or linear preference which were to include field-dependence and independence in the ratio. (Thus, field-dependence, or rather its inverse, enters into the denominator of the new H/S ratio, since one can expect that field-independence and propositionality represent fairly identical learning abilities.) Consequently, three measures were used to identify the learners--these being: Gestalt Completion, Vocabulary, and Hidden Figures tests. All three were drawn from the ETS "Kit of Factor Referenced Cognitive Tests" after a pilot study indicated that other tests (which would have been somewhat more difficult to use) preferred by previous researchers, correlated well with the ETS measures (and appeared to asses the same qualities) and could consequently be omitted for the sake of simplicity.

The "treatments" that were developed to provide a match or a mismatch to the cognitive style ratios, were two instructional programs. Their differences derived from multi-image research. Both were pre-programmed tape-slide presentations that were specifically designed for this study. They provided accelerated overview introductions to the basics of photography. The linear version used a conventional "slide show" organization, whereas the non-linear version was executed in the style of single slide multi-imagery. That is, each consecutive slide represented a composite of from one to four individual slides, so copied onto one slide as to simulate a multi-projector, multi-screen presentation. The content, organization, and "crucial" images were the same in the two presentations. Both had about 158 slide changes--however, the multi-image version offered 250 different images as compared to the 158 in the conventional version. The multi-image, or non-linear, version ran about 33 minutes with a condensed, rapidly paced narration whereas the conventional, or linear, version ran 42 minutes with a more leisurely paced and somewhat more conversational narration. Thus, the non-linear presentation offered visual redundancy and simultaneity and the linear version verbal redundancy and relaxed pacing.

Another factor that the study included as independent variables were both the timing and the mode of testing for the learning resulting from the instructional treatment. Learning was measured with both immediate posttests as well as with delayed retention tests using two sets of counterbalanced tests in three modes: constructed response, multiple choice, and pictorial interpretation.

Lastly, it became apparent that (because of random assignment to the the two treatment groups) the inclusion of residual pretest scores as a covariable was logically necessary. Cutoff scores on the pretest were used to remove from the study those learners who were already familiar with the subject matter. However, it was apparent that performance averages below the cutoff level differed for the two groups and hence needed to be accounted for in the multiple regression analyses.

METHOD

An initial participating population of about 250 college students became reduced by attrition at several stages to a sample of 190 whichpretesting further reduced to the 150 who were available for analyzing the immediate posttest results with about 112 participants available for delayed retention test analysis. Participants provided some demographic and preference data and underwent pretesting for content familiarity. They then completed three measures, all drawn from the 1976 edition of the ETS "Kit of Factor Referenced Cognitive Tests," earlier versions of which were referred to as the "French Kit." The selected tests were: a) the Gestalt Completion Test (CS-1), both parts, b) the Extended Range Vocabulary Test (V-3), first part, and c) the Hidden Figures Test (CF-1), second part. Total testing time was thus about a half hour.

Next, the participants were randomly assigned to the two presentations, which were followed by the three-mode posttest packet that also included some affective inquiries. The posttest required about 20 minutes. Following a delay of some days, each particpant received a counterbalanced alternative form of the posttests and affective inquiries accompanied by questions regarding content-related activities during the interim.

The test results were scored, tabulated, and coded for computerized data processing using the multiple regression subprogram REGRESSION, available in "package form." This is documented in the second edition of the Statistical Package for Social Studies (SPSS). The REGRESSION program enables the hierarchical entering of the variables so as to account for the effects of all possible variables before one attempts to ascertain any interactions due exclusively to the aptitudes and treatments being investigated. To test for the presence or absence of statistically significant interactions, the variables were entered into the equations for each of the six outcome measures using the following order: a) performance on the covarying pretest (below cutoff point), b) performance scores on the various single (or combined) cognitive style measures, c) the treatment variable (coded as either "1" or "2"), and d) the various interaction constructs obtained by multiplication of the cognitive style outcomes with the treatment code. (For details on the analysis, cf. Kerlinger & Pedhazur, 1973.)

Thus, each of the three "modes," or measures of learning (either when used as immediate posttest or as delayed retention test) was evaluated in terms of the holistic/serialistic (S/H) ratio as well as in terms of performance on each of the component measures of cognitive style. The H/S ratio was derived from standardized "*T*-scores" computed from the gestalt completion (GES), the vocabulary (VOC), and the hidden figures (HFG) test scores as follows:

$$H/S = \frac{2 \times (T\text{-score of GES})}{(T\text{-score of VOC}) + (T\text{-score of HFG})}$$

As secondary considerations of the study, the presence of any statistically significant aptitude effects on the learning outcomes were checked, as were any treatment main-effects on performance. Last, some of the possible interactions based in the affective domain, as determined by opinion questions, were also statistically evaluated.

RESULTS

No statistically significant aptitude-treatment interactions emerged from the regression analyses performed on the data. Preliminary analysis had yielded some substantial interactions, but further inspection of the data indicated the need to incorporate pretest scores as covariates, which in turn eliminated the observed interactions. Thus, the research hypothesis, or the expectation of the matching

conditions (holistic learners and the non-linear instructional treatment as well as serial learners and the linear instructional treatment) yielding better outcomes than the mismatching condition, could not be supported.

Some secondary observations of interest *were* made. Thus, an interaction between instructional strategy and testing mode was observed: those receiving the linear, more verbally-oriented, presentation performed significantly better on the task requiring writing the answers out longhand, than did the group receiving the more visually-oriented presentation. Hence, written responses seem easier to produce following a more verbal instruction. Also, a significant increase in delayed retention test scores, on the task based on multiple-choice answers, was observed compared to performance on the immediate posttest. However, this effect was not significantly related to any treatment differences. Apparently, the frequently mentioned improvement in retention, associated with multi-image presentations, applies equally to learning from all "slide-shows" (no matter in which format) so long as learning is measured by multiple-choice tests. None of this improvement could be related to the respondents' between-tests activities, and hence cannot be ascribed to any acquisition of additional information.

Another interesting observation was the discovery that very few college students could be considered to be "holists" in the sense of the H/S ratio, that is those who score high on the gestalt closure test while simultaneously scoring low on both vocabulary and hidden-figures tests. Indeed, if a score in the top or bottom thirds of each measure were required to assign a participant to the "high" or the "low" classification, then less than 10% of the entire sample of 190 would fall into the combined "holist" *and* "serialist" categories, with 90% falling into a "middle of the road" category. Thus a possible "filtering out process" appears to take place in our educational system which may make the effort to design special "matched" instructional materials a trivial task. This, of course, does not prove that some *other* construct similar to the H/S ratio may not be found to yield more meaningful results, or that more interesting results couldn't be found with different populations.

IMPLICATIONS

It is not possible to identify whether failure to find interactions between treatments and aptitudes can be said to result from a) no such interactions being possible, b) the treatments not having the expected characteristics, or c) the cognitive style measures not measuring the expected "holistic" or "serialistic" learning preference.

Other research has used different measures and some have obtained observable differences with some treatments, but, typically quite different statistical analyses were used. The treatments in this study, in an effort to make them "ecologically valid" as examples of "linear" and "non-linear" presentations, did not maintain most of the variables constant between them. Thus, future studies done in this vein, should consider retaining both the time and narrative constant while only varying the visual aspects. Furthermore, there also exists the opposite possibility of making the two versions even more divergent by modifying the internal conceptual organization of the non-linear version so as to make its logical development non-linear as well.

In addition to the measures used in this study, there exist numerous other appropriate cognitive measures-even of gestalt completion, or holistic processing--which merit further consideration. Both the "Mooney Faces" (Mooney, 1957) as well as other possible face recognition tasks suggest themselves as likely candidates for measuring holistic aptitudes. Similarly, it maybe worth waiting to see what kind of success the new computerized "Spy Ring History Test" recently available from B.C.E. Scott might enjoy (cf. Pask & Scott, 1972) as a novel "holistic" measure.

One of the benefits to be derived from this study may well be the methodology used here for attacking this type of problem. It is felt that it is probably somewhat more cautious in its approach than many others that the author has encountered in the literature and would be well worth considering when developing future aptitude-treatment interaction research designs.

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